RANDOM ACCESS
BOX 41770
PHOENIX, ARIZONA 85080

DVC-2

If you are an owner of a Sinclair ZX-81 or TS1000 computer, you are a member of a very large group world wide. These little computers are being manufactured and sold at an incredible rate. Low price and easy availability make them a very desirable first computer for those wishing to learn more about computers and programming without taking out a second mortgage on the house to pay for it. The low price unfortunately means that some optional extras have been left off. For instance the video signal generated by the ZX-81 must be fed to the T.V. monitor through the antenna terminals. Although the image obtained after processing through the tuner and I.F. amplifier is acceptable in most cases, it is a far cry from the crisp, sharp characters afforded by a wide band video monitor with a direct video input. If you own a wide band monitor it cannot be used with the Sinclair since no provision has been made for a direct video output on this computer.

A second irritant to many people is the black character on white background video format that has been chosen for the ZX-81. Most computers employ the opposite, white on black, and many people feel that this type of presentation is less of an eyestrain. In the original Sinclair computer, the ZX-80, it was a simple matter of adding a SPDT toggle switch to be able to select either format. The ZX-81 is a whole different ballgame however, since the point at which the switch must be connected is buried inside a custom LSI integrated circuit.

The project that follows is a soulution to both problems. A small single sided circuit board measureing only 1.4 inches by 2.4 inches fits easily inside the ZX-81 and provides both a direct video output and switch selectable normal or inverse video.

If direct video were our only requirement, implementation would be a breeze, since it would only be necessary to add an emitter follower stage to buffer the signal already being fed to the computers R.F. modulator. Inverting the video is a little tricker. It is not acceptable to simply invert the entire signal as this would also invert the sync pulses making it impossible for the monitors sync separator to operate properly.

In order to do the job right we must separate the two components of the composite video signal, and invert only the video portion, leaving the sync pulses as they are. Next we must maintain the proper ratio of sync pulse amplitude to video amplitude. An finally the correct peak to peak amplitude and output impedance suitable to drive a standard video monitor must be provided.

CIRCUIT DESCRIPTION

The first stage, Q1, is a buffer amplifier which has a low output impedance capable of driving the stages that follow. The input impedance is controlled by the value of R1.

The composite video signal from Q1 is applied to one input of U1-B, 1/4 of a quad exclusive-or gate. This gate actually performs two functions. First it acts as a simple inverter, providing an output which is 180° out of phase with the input. Second, it acts as a comparator to separate the sync pulses

from the video. Each sync pulse brings pin 2 of U1 all the way to ground potential, the video however never drops below 2.0 volts. This means that as far as the gate is concerned the input is always HIGH except during sync pulse time. The output at pin 3 is therefore an inverted version of composite sync containing no video.

Transistor Q2 converts the composite video signal into a logic compatiable format in which both sync pulses and video information are the same amplitude. This is done by dropping most of the sync pulse voltage across diodes D1 and D2. As a result Q2 will not begin to conduct until the signal voltage reaches a level of approximately 2.1 volts (three diode drops). Since the video voltage is active at 2.0 volts Q2 switches for both video and sync voltage.

Diode D3 is a schottky type with a forward drop of .3 to .4 volts. Its purpose is to increase the switching speed of Q2 so that full video bandwidth will be obtained. It does this by preventing Q2 from saturating thus eliminating the long storage time that would otherwise occur. As Q2 turns on and attempts to saturate, D3 becomes forward biased and begins to bleed off base drive. The collector of Q2 can never get any lower in potential than the difference between its forward Vbe drop and the forward drop of D3, or about 300 millivolts. This effectively prevents saturation and eliminates storage time.

The logic level signal at the collector of Q2 next goes to pin 4 of U1-A which is configured as a programmable buffer. With S1 in the "norm" position U1-A will act as an inverter, but with S1 in the "inverse" position it will perform as a non-inverting buffer.

Pin 9 of U1-C receives a composite signal consisting of both video and sync pulses. Pin 10 sees only the inverted sync from the output of U1-B. The exclusive-or action of U1-C cancels out the two sync pulses at the input leaving only the video signal at the output. U1-D inverts the sync pulses for the second and last time.

The two outputs from U1-C and D are combined by the scaling network consisting of R6, R7, R8, and D4. This network provides the proper ratios of sync pulse to video and applies the result to the base of Q3, a high input impedance emitter follower stage. Q3 has a 75 ohm resistor in its emitter leg to provide the proper impedance for driving a standard video coax and monitor.

CONSTRUCTION

The direct video converter is best built using a printed circuit board, the pattern for which is shown full size in Figure 2. Fill the board and solder the components down following the component guide of Figure 3. Be sure and orient U1 properly. Also mount the three transistors as close to the surface of the P.C. board as possible.

INSTALLATION

Begin the computer modification by drilling a 1/4 inch hole in the upper right hand side of the top half of the case to accept the miniature toggle

switch S1. Next, looking at the opposite side, drill a no. 32 hole approximately 5/8 of an inch to the right of the indentation for the 9 volt connector. Drill the hole in the center where the two halves meet. Disassemble the computer by removing the five screws holding the two halves together (three are under the rubber feet). Pull the bottom half off and set it aside. Remove the two screws holding the printed circuit board and carefully lift it up. Be extremly careful working with the loose circuit board. The flex print connecting the keyboard to the computer is very fragile and easily damaged. Do not attempt to remove it from its connector, as this will only increase the likelihood of damage.

Position the completed circuit board as shown in Figure 4. Mark the inside of the case through the mounting holes of the P.C. board, and drill two no. 32 holes in the places marked.

Refering to Figure 5 remove R31, R32, and D9 from the computers circuit board. This network is used to scale the video voltage applied to the R.F. modulator and is no longer needed. The video signal from the conversion board is already scaled properly and is applied directly to the modulator input. Next, install four wires, each at least 8" in length, and solder them to the four feedthru holes indicated in Figure 5. One of the feed-thrus, the input to the modulator, will have been vacated by R31's removal.

Now you are ready to interconnect everything as shown in Figure 6. Use RG174U coax for the direct video output as this type is only about 1/10 of an inch in diameter. Tie a knot in the cable at the point at which it will exit the computer (the no. 32 hole you drilled near the 9 volt connector) to act as a strain relief.

Mount the conversion board to the inside of the top half of the computers cover using two #4-40 X 1/2" machine screws. Be sure and place two fiber insulating washers over each screw before installing the conversion board. This will prevent the bottom of the board from being shorted by the aluminized coating on the inside of the cover.

USING THE COMPUTER

After reassembling the computer you are ready to connect it to your video monitor. If you are using a black and white T.V. which has been modified for direct video, you will obtain the best results with the contrast control set nearly fully counter clockwise (minimum video amplifier gain) and the brightness control set a little lower than normal. If your monitor does not employ D.C. restoration, and most do not, you will have to readjust the brightness control each time you switch from normal to inverse video or vice versa.

As a final note, you may find it interesting that the size of the pixels that make up the characters can be controlled to some extent by varying the values of resistors R1 or R2. R1 can be adjusted between 1 and 2K and R2 varied from 75 ohms to 1K or so. What this does is change the D.C. bias point and thus modifys the amount of time that Q2 has to react to the video voltage.

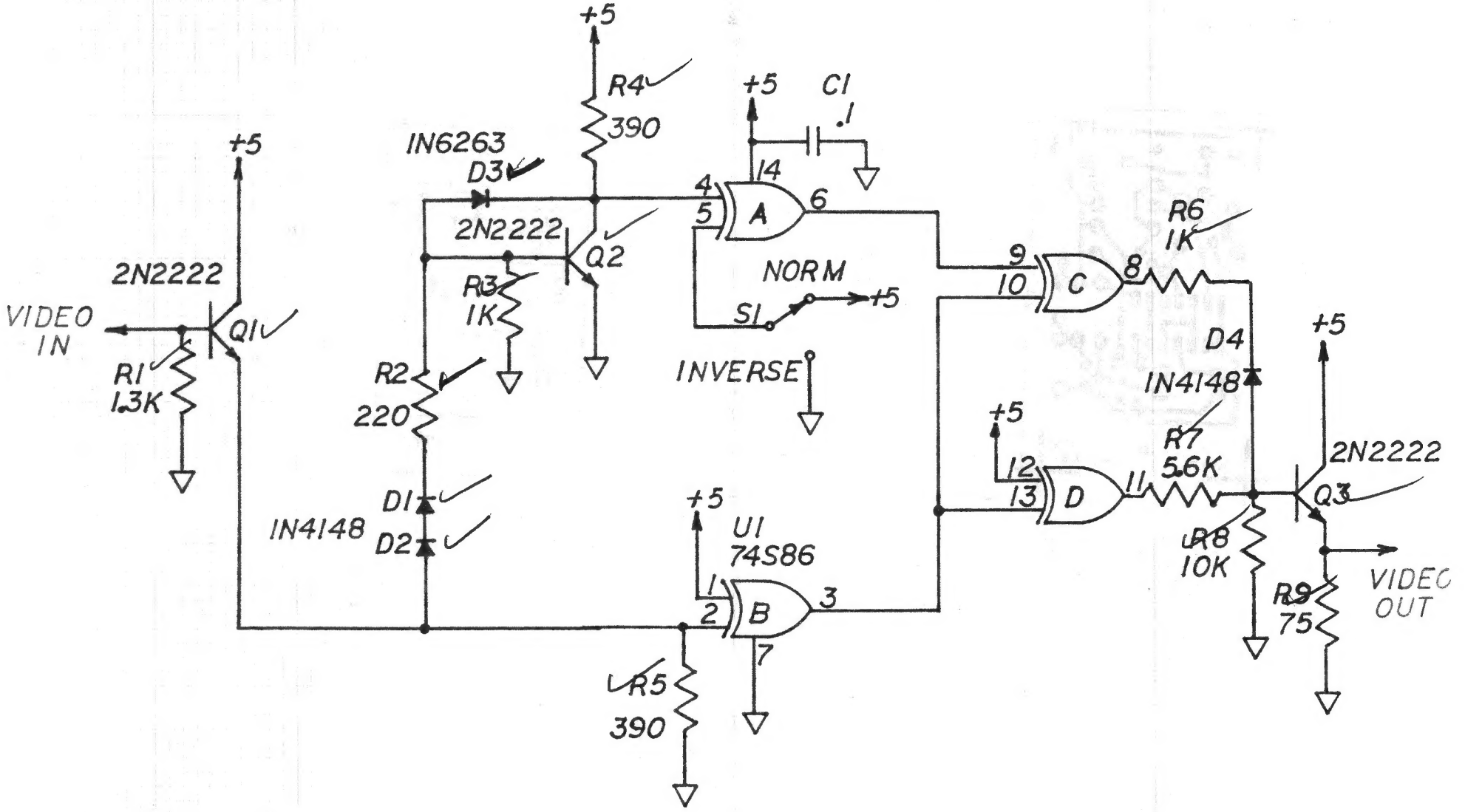

+5
R4
390
IN6263
D3
+5
C1
.1
14
4
5
A
6
2N2222
Q2
R3
1K
NORM
S1
+5
INVERSE
+5
VIDEO
IN
2N2222
Q1
R1
1.3K
R2
220
D1
IN4148
D2
+5
U1
74S86
1
2
B
3
7
R5
390
9
10
C
8
R6
1K
D4
IN4148
+5
12
13
D
11
R7
5.6K
2N2222
Q3
R8
10K
R9
75
VIDEO
OUT

FIG. 1

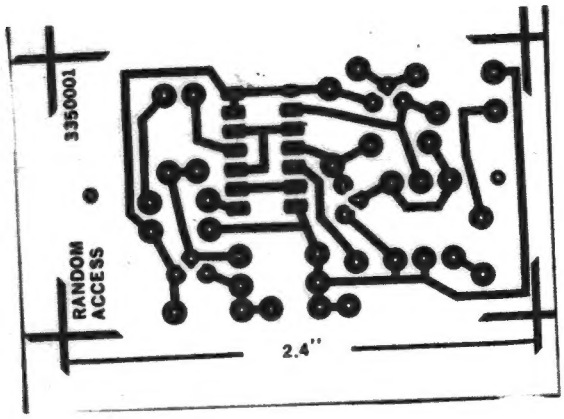

3350001
RANDOM ACCESS
2.4"

FIG. 2

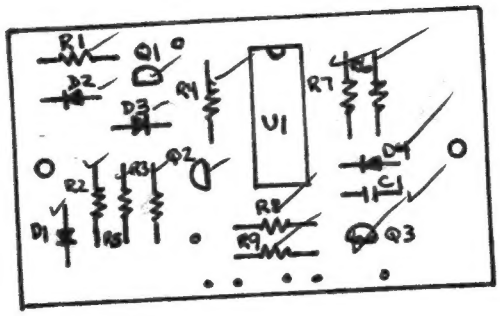

R1
Q1
D2
D3
R4
U1
R7
D4
C1
R2
R3
Q2
R8
R9
D1
R5
Q3

FIG. 3

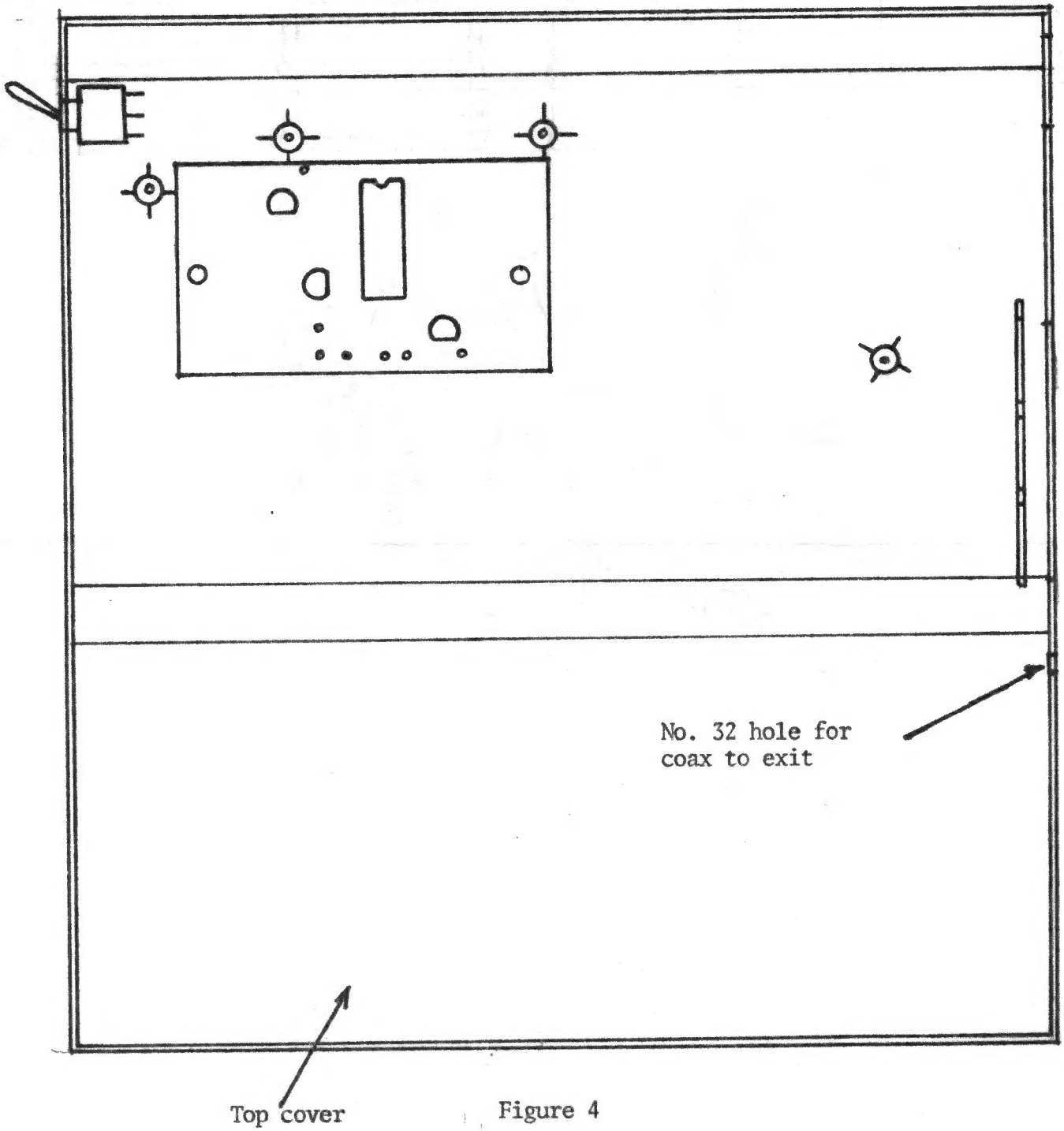


Figure 4

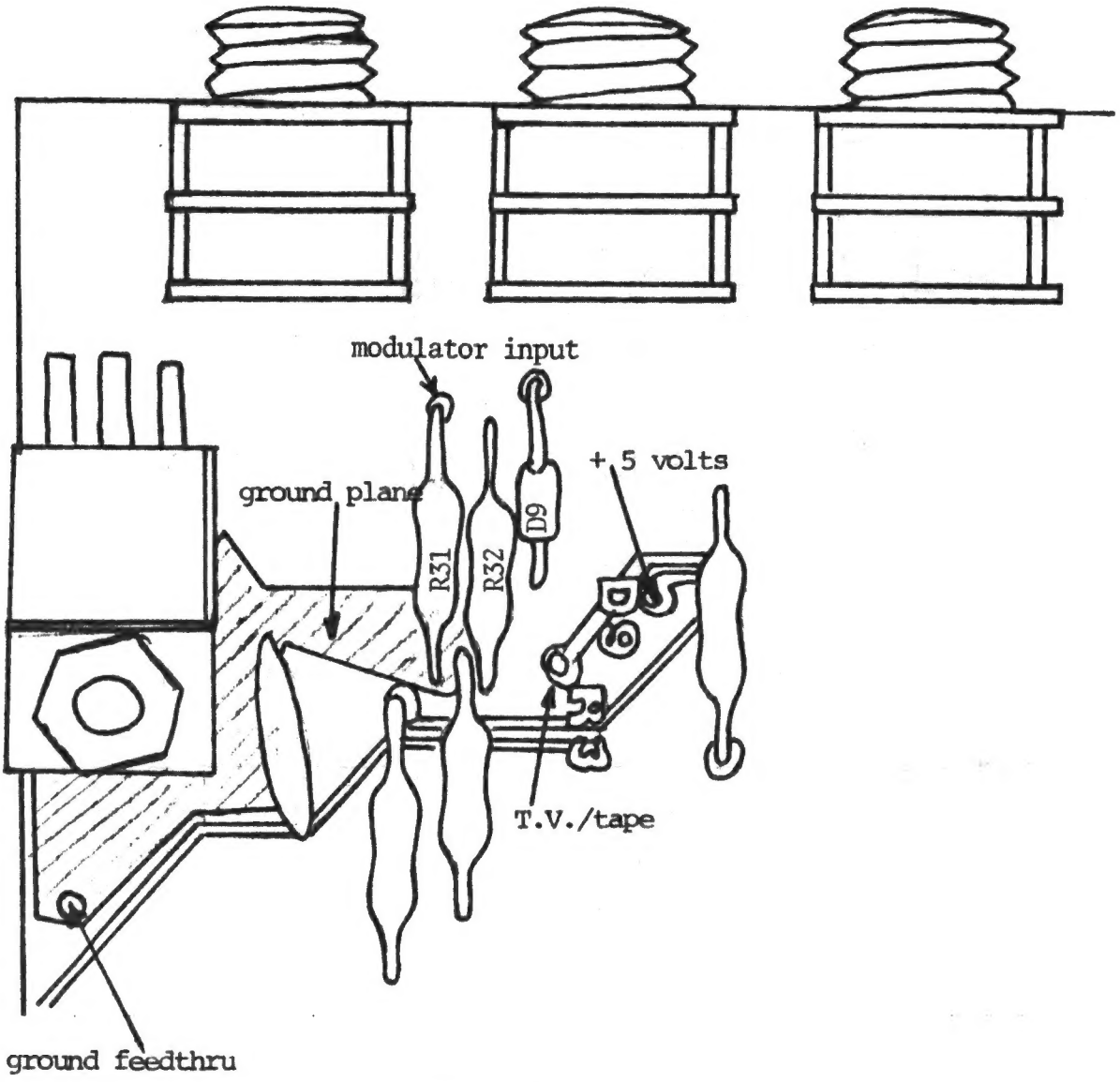

modulator input
+5 volts
ground plane
R31
R32
D9
T.V./tape
ground feedthru

FIGURE 5

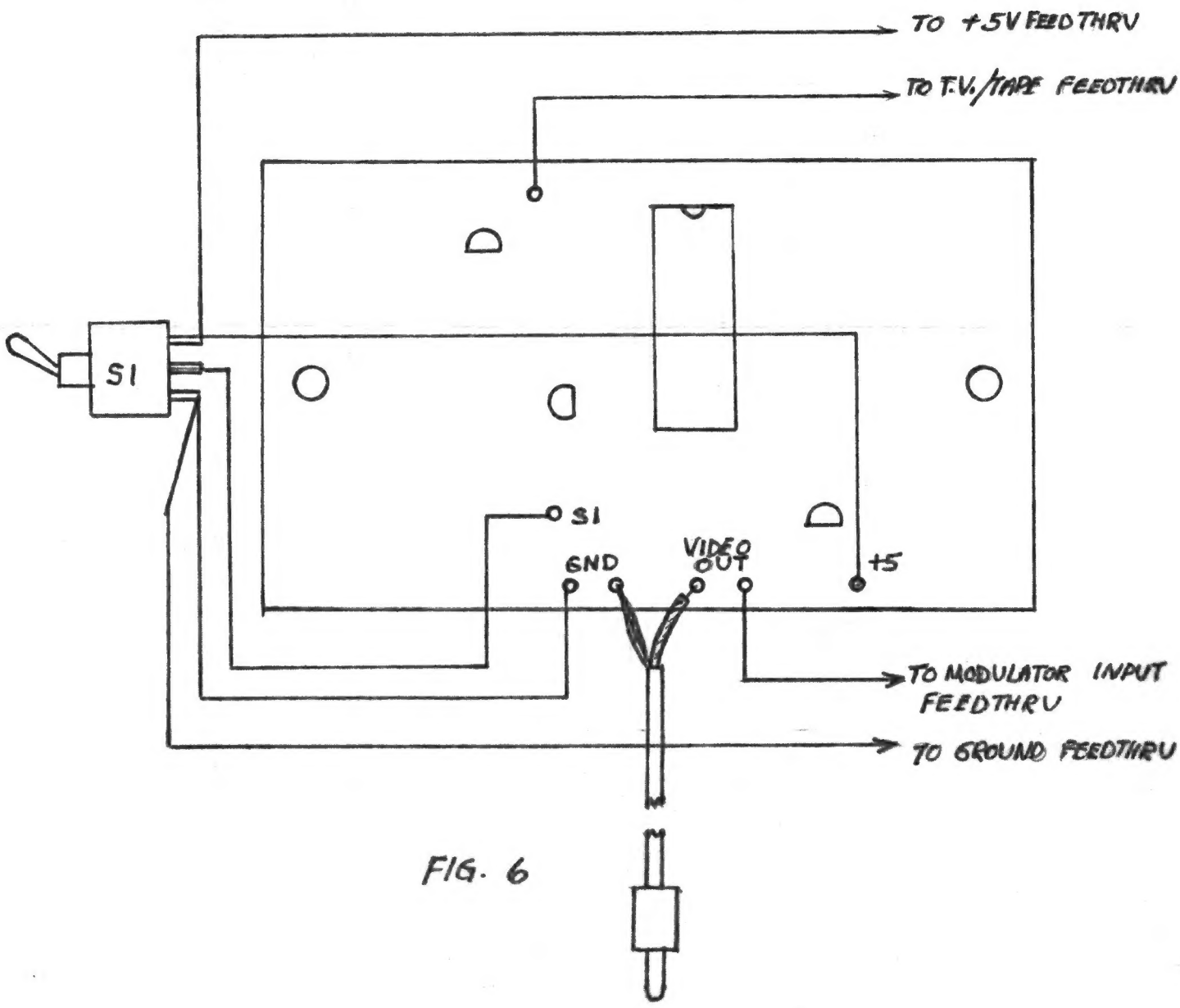

TO +5V FEEDTHRU
TO T.V./TAPE FEEDTHRU
S1
S1
GND
VIDEO OUT
+5
TO MODULATOR INPUT FEEDTHRU
TO GROUND FEEDTHRU

FIG. 6

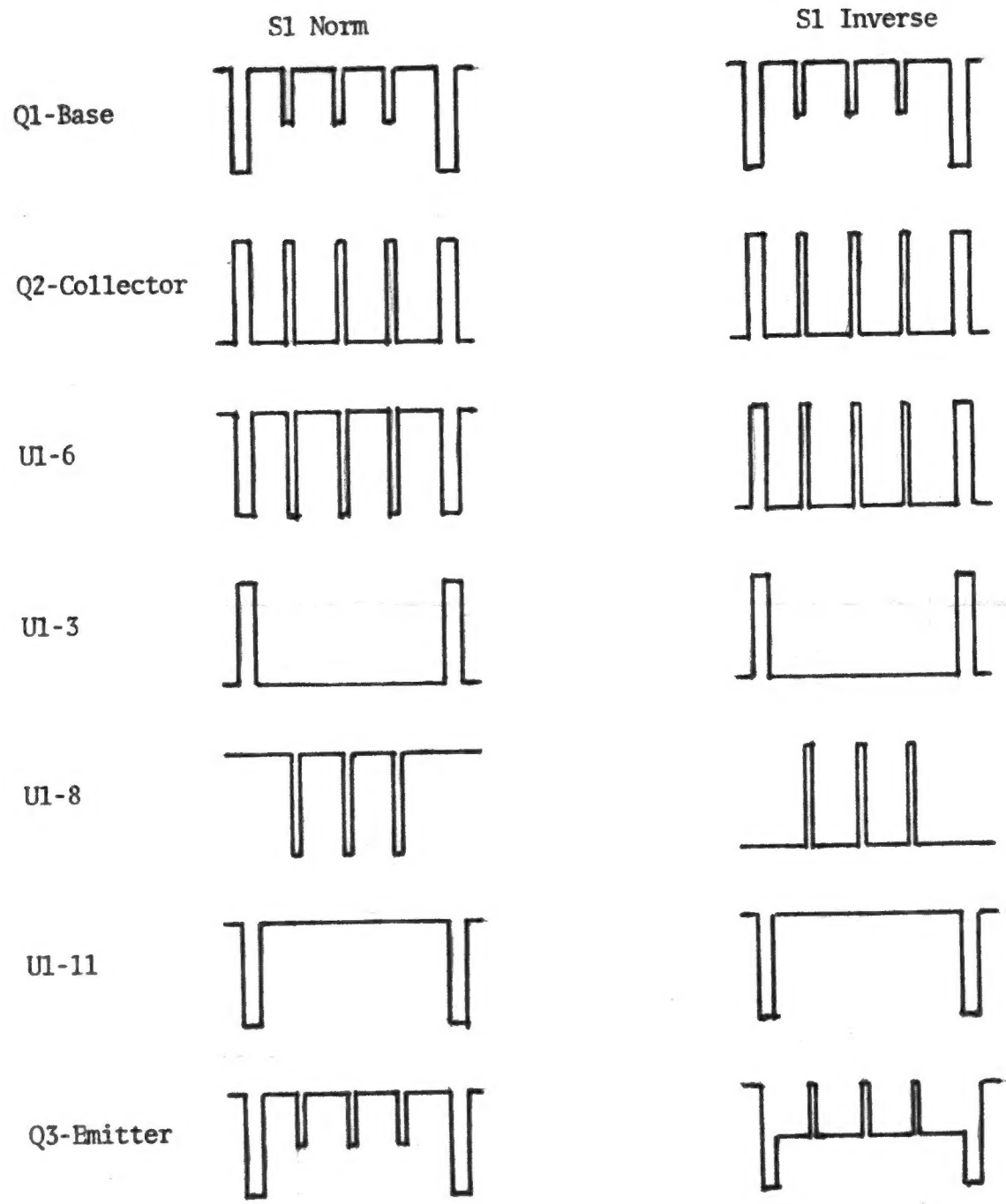
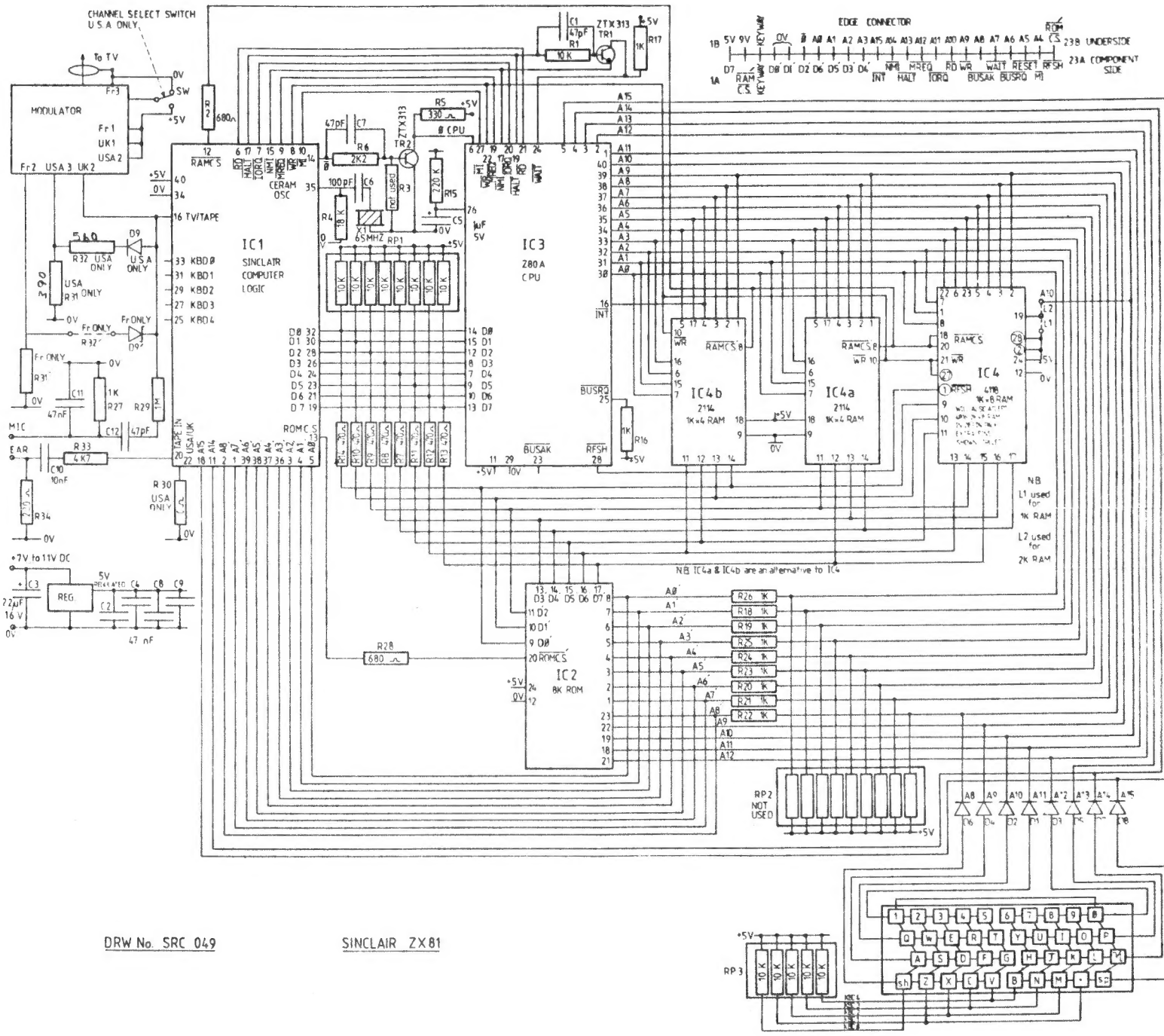
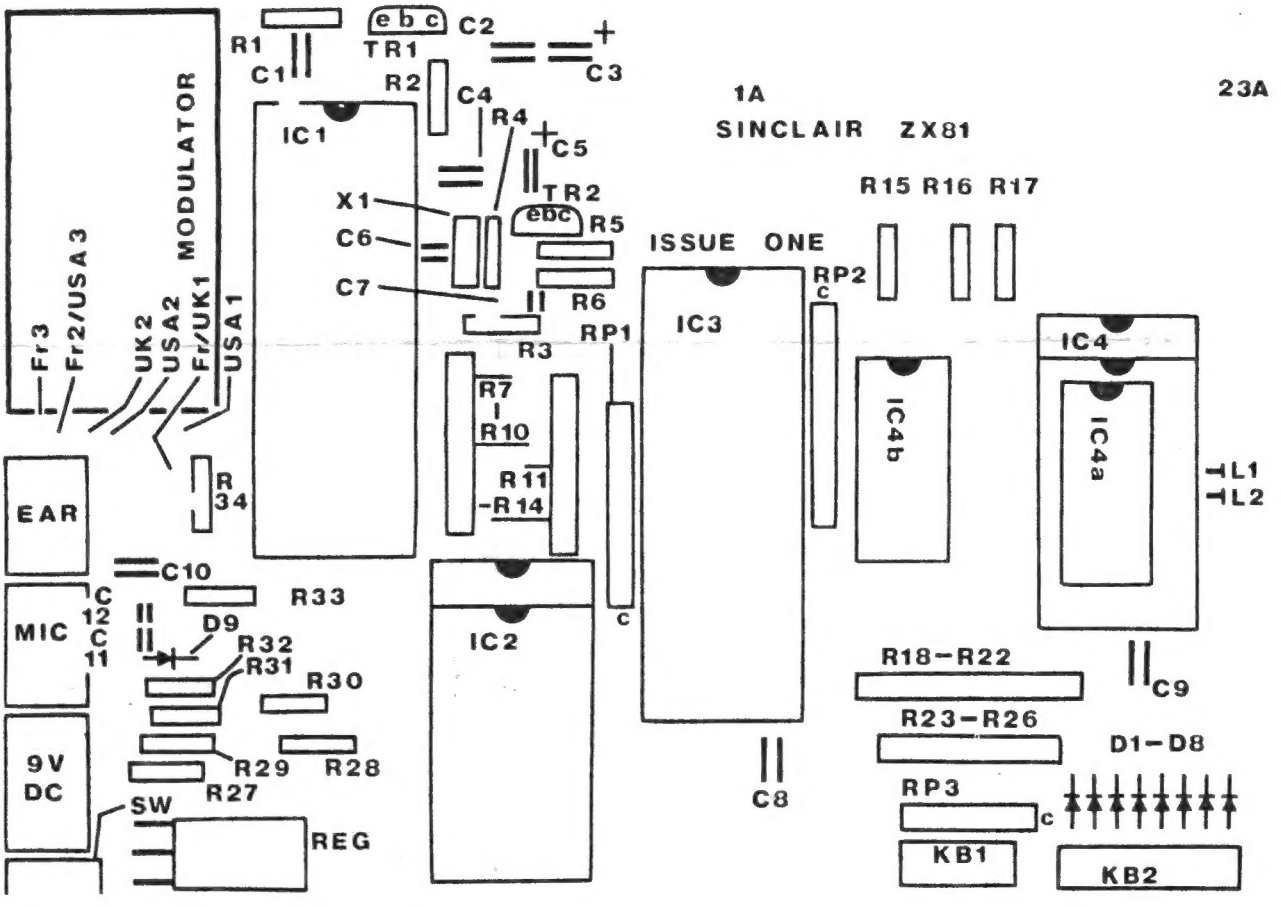

S1 Norm
S1 Inverse
Q1-Base
Q2-Collector
U1-6
U1-3
U1-8
U1-11
Q3-Emitter

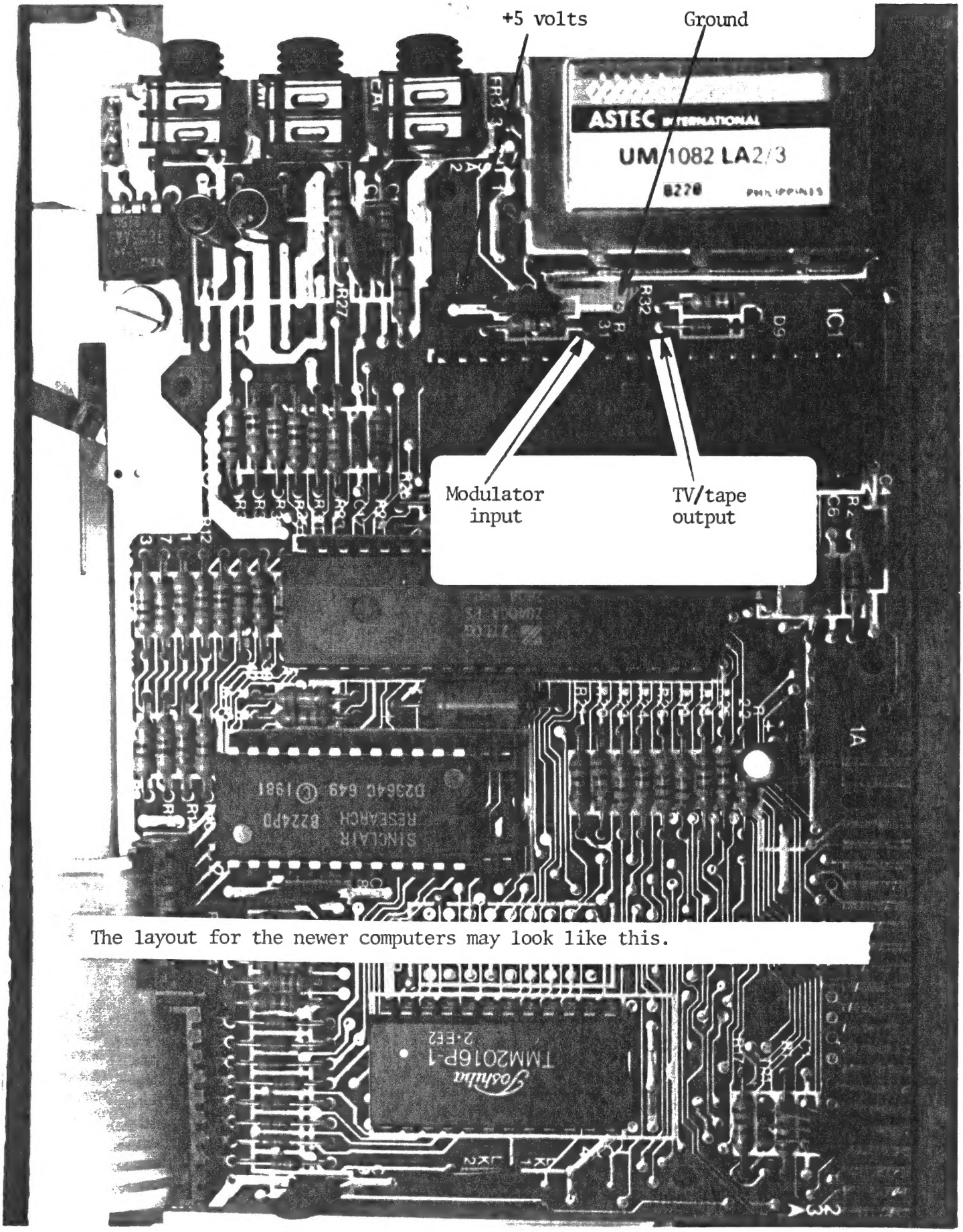
Figure 7



DRW No. SRC 049

SINCLAIR ZX81


1A
SINCLAIR ZX81
23A
ISSUE ONE
MODULATOR
Fr3
Fr2/USA3
UK2
USA2
Fr/UK1
USA1
R1
C1
TR1
C2
C3
R2
C4
R4
C5
IC1
X1
C6
C7
TR2
R5
R6
R3
RP1
IC3
RP2
R15 R16 R17
IC4
IC4b
IC4a
L1
L2
R7
R10
R11
R14
R34
EAR
C10
R33
MIC
C12
C11
D9
R32
R31
R30
IC2
C
C8
C9
R18-R22
R23-R26
D1-D8
9V
DC
R29
R28
R27
SW
REG
RP3
KB1
KB2



The layout for the newer computers may look like this.

WARRANTY:

Random Access warranties this kit to be free of defects in material and workmanship for a period of 35 days from the date of shipping. Defective, damaged, or missing components will be replaced during the warranty period. Defective components should be returned along with $.50 for return postage and handling

DISCLAIMER OF LIABILITY:

Installation of this device may void your computers warranty. Random Access has no control over the quality of workmanship used to construct and install the DVC-2 direct video kit. Random Access cannot assume responsibility or liability for any incidental damage to or failure of a device used with the direct video kit.

SERVICE:

It is the responsibility of the kit builder to perform any necessary troubleshooting if the assembled unit does not function properly. If you are unable to isolate the problem Random Access will provide a repair service at a cost of $10.00 per unit. The defective unit should be shipped by mail to:

Random Access
Service dept.
Box 41770
Phoenix, AZ
85080

Include all components, including the toggle switch, coax, and RCA connector. Remember, 90% of all failures are due to poor soldering or a shorted coax cable. Check these before returning your unit.

WE DO NOT REPAIR COMPUTERS- ONLY THE DVC-2.

If you send us your computer along with the defective DVC-2, please include $4.50 for return postage and insurance.